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JPRS L/9002

26 March 1980

USSR Report

ENGINEERING AND EQUIPMENT

(FOUO 3/80)

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JPRS L/9002

26 March 1980

USSR REPORT

ENGINEERING AND EQUIPMENT

(FOUO 3/80)

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NAVIGATION AND GUIDANCE SYSTEMS

UDC 531.383

ON THE CHOICE OF SIGNAL MEASUREMENT TIME IN A GYRO-OPTICAL COMPASS

Leningrad IZVESTIYA VUZ MV I SSO SSSR: PRIBOROSTROYENIYE in Russian Vol 22 No 6, Jun 79 pp 64-68 manuscript received 28 Feb 78

[Article by V.V. Seregin, Leningrad Institute of Precision Mechanics and Optics]

[Text] Formulas are derived for the operation of a gyro-optical compass on a stationary base and a selected model for the errors of a laser gyroscope, where these formulas relate the one-time signal measurement time and the laser gyroscope errors, which are the determing ones in the specified compass configuration. The input signal level quantization errors are taken into account in this case.

The utilization of a laser gyroscope to solve the problem of gyrocompass design involves certain specific features of the measurement of its output signal. This is due to the fact that the output parameter of a laser gyroscope is the beat frequency, which can be measured with high precision only using digital methods [1]. For this, the output signal must be converted to a pulse train, i.e., the signal must be quantized with respect to the level. A consequence of this is the quantization error. Moreover, it is necessary to take into account the fact that during gyrocompass operation, it is necessary to measure the comparatively low angular velocity which corresponds to the low beat frequency. In line with the operational principle of digital frequency meters, a comparatively large measurement time is required to measure these frequencies, where this time also depends on the requisite precision.

Since one of the characteristics of any gyrocompass circuit is its operational speed, the question of the choice of the signal measurement time of a laser gyroscope is an extremely important one in analyzing gyro-optical compass operation. It is obviously expedient to consider the operational speed in its interrelationship with the gyrocompass precision, which is determined both by the gyro-optical compass configuration and the azimuth computation algorithm. In studying this question in the following, we shall consider the additive errors introduced by the laser gyroscope itself and the errors in the measurement of its output signal, assuming that the laser gyroscope is mounted on a stationary base with respect to the earth, where this base has been horizontally leveled with ideal precision.

Under these assumptions, we can represent the noise in the output signal of the laser gyroscope in the following form:

$$F_п = F_0 + a \cdot t + F_c(t), \tag{1}$$

where F_0 is the displacement of the output characteristic zero, which has a nonzero expectation value $\bar{F}_0$ (the mean square deviation of the zero displacement, σ_0, characterizes the reproducibility of a measurement from activation to activation); a is the rate of zero drift, which we shall consider to be a random quantity with a zero expectation value and a mean square deviation σ_a (a characterizes the long term frequency instability [2]); $F_c(t)$ is the fluctuation in the frequency, which can be considered as white noise with a dispersion σ_F^2 in a certain range of frequencies ($F_c(t)$ defines the short term instability of the laser gyroscope signal).

For the simplest configuration of a single component gyro-optical compass, the time for the one-time measurement of the azimuth in [3] is determined by the following formulas:

$$T = \frac{n}{2k \cdot \omega_{др}} \quad (2) \qquad\qquad T = \frac{\sqrt{1+n^2}}{2k \cdot \delta A \cdot U \cdot \cos\varphi} \quad (3)$$

where $n = \omega_{др}/\Delta p$ is the ratio of the zero drift, $\omega_{др}$, to the error in the measurement of the laser gyroscope output signal, Δp, refernced to its input; k is the laser gyroscope scale factor; $U \cdot \cos\phi$ is the horizontal component of the angular rotational speed of the earth; δA is the azimuth computation error.

Thus, formula (2) establishes the relationship between the signal measurement time and the laser gyroscope parameters, while formula (3) determines the measurement time as a function of the gyro-optical compass error.

In the case where the laser gyroscope operates as a pulse amplitude modulated system [4], the following number of pulses are fed to the bidirectional counter during the measurement time:

$$N = \int_0^T F_п(t) \cdot dt + k \cdot T \cdot U \cdot \cos\varphi \cdot \cos A \pm q, \tag{4}$$

where q is the error in the measurement in the input signal, due to its level quantization. The quantization error obeys an equiprobable distribution law and has the following mean square deviation for the case of a zero expectation value:

$$\sigma_{\kappa} = \frac{1}{2\sqrt{3}} \quad \text{(of a pulse)} \tag{5}$$

Given the condition that the systematic error of a gyro-optical compass, which is due to the expectation value of the zero shift of the laser gyroscope characteristic, can be calculated and compensated with sufficient precision, the reproducibility of the measurement results will exert the greatest influence on the operation of the simplest compass configuration. This is manifest in the form of an additional number of pulses, which is characterized by the mean square deviation

$$\sigma_{N0} = \sigma_0 T. \tag{6}$$

It is easy to find formulas from expression (4) for the error in the calculation of the angle A due to the influence of the zero shift and the quantization error. Taking (5) and (6) into account, these formulas can be written in the form:

$$\sigma_{A1} = \sigma_0 \frac{\operatorname{cosec} A}{k \cdot U \cdot \cos\varphi} \quad (7) \qquad \sigma_{A2} = \frac{\operatorname{cosec} A}{2\sqrt{3} \cdot T \cdot k \cdot U \cdot \cos\varphi} \tag{8}$$

We choose the measurement time from the condition, under which the quantization error (8) can be disregarded as compared to the error due to the zero shift (7). The negligible error criterion of [5] can be used as this condition:

$$\sigma_{A2} \leqslant \frac{1}{3}\sigma_{A1}. \tag{9}$$

By substituting formulas (7) and (8) in (9), we derive an expression following transformation which defines the choice of the measurement time:

$$T > \frac{\sqrt{3}}{2\sigma_0} = \frac{\sqrt{3}}{2k \cdot \sigma_\omega}, \tag{10}$$

where σ_ω is the mean square deviation of the zero shift, referenced to the input of the laser gyroscope. It can be seen from (10) that with an improvement in the laser gyroscope reproducibility (σ_0 decreases), the measurement time increases. But in this case, the fact that the gyrocompass error falls off, remaining at the level of (7), must be taken into account. In this sense, formula (10) determines the optimal time for a one-time measurement, which is expediently broken down into two equal intervals, during which the signs of the frequency pedestal will be opposite. This will permit a reduction in the influence of the long term frequency instability, through the exclusion of the change in the size of the frequency pedestal.

A similar problem, but with a different model for the errors of a laser gyroscope, was treated in paper [6].

If the procedure considered here for the determination of the measurement time is applied with the same presupposition to the compass configuration in which two laser gyroscopes are used with mutually perpendicular input axes, then we obtain an expression which agrees with formula (10). Thus, a dual component configuration for a gyro-optical compass has no advantages in terms of operational speed as compared to the single component configuration. However, this can be confirmed only for the selected model of the laser gyroscope errors and the given method of processing its output signal.

We shall treat a single component gyro-optical compass configuration, in which, just as in [7], two measurements are made at different positions of the input axis of the laser gyroscope in the horizontal plane. If the laser gyroscope is rotated without the vertical axis through 180°, then the algorithm for the calculation of the azimuth is

$$A = \arccos \frac{N_1 - N_2}{2T \cdot k \cdot U \cdot \cos \varphi}, \tag{11}$$

where N_1 and N_2 are the numbers of pulses registered in the bidirectional counter for the corresponding positions of the laser gyroscope. Taking (1) into account, these values can be represented in the form:

$$N_1 = \int_0^T [F_0 + a \cdot t + F_c(t)]\,dt + k \cdot T \cdot U \cdot \cos\varphi \cdot \cos A \pm q, \tag{12}$$

$$N_2 = \int_T^{2T} [F_0 + a \cdot t + F_c(t)]\,dt - k \cdot T \cdot U \cdot \cos\varphi \cdot \cos A \pm q. \tag{13}$$

Each of these measurements contains a quantization error. Its influence on the error in the calculation of the azimuth A wil be determined by formula (8).

Performing the integration in (12) and (13), and substituting the result in (11), it is not difficult to confirm that the displacement of the laser gyroscope zero in this compass configuration does not yield an error in the azimuth calculation. For this reason, when finding the condition for the determination of the signal measurement time, it is necessary in this case to take into account the error due to the zero drift, the mean square deviation of which is

$$\sigma_{A3} = \frac{\sigma_a \cdot T \cdot \operatorname{cosec} A}{2 \cdot k \cdot U \cdot \cos\varphi}. \tag{14}$$

Summing the errors of (8) and (14), we obtain a function which has a clearly pronounced minimum at a certain value of the measurement time. This time is determined by the function:

$$T^2 = \frac{\sqrt{3}}{3\sigma_a} \tag{15}$$

and is optimal in terms of the criterion of a minimum in the mean square error. The gyrocompass time will be composed of the time for the execution of two measurements:

$$T_r = 2\sqrt{\frac{\sqrt{3}}{3\sigma_a}} = \frac{1,52}{\sqrt{\sigma_a}}. \tag{16}$$

In this case, the error in gyrocompass operation due to the zero drift and the signal quantization will amount to:

$$\sigma_A = \sqrt{\sigma_{A2}^2 + \sigma_{A3}^2} = \frac{0,537 \operatorname{cosec} A}{k \cdot U \cdot \cos\varphi} \sqrt{\sigma_a}, \tag{17}$$

and will define the maximum achievable error given ideal filtering of the fluctuations in the output signal of the laser gyroscope.

If the gyrocompass operates with two signal measurements, then the application of the negligibility criterion to the quantization error yields an overstated measurement time and value of the azimuth calculation error, and consequently, does not allow for the determination of the optimum measurement time.

As an example, we shall use the derived formulas to calculate the parameters of the laser gyroscope cited in [8]: the reproducibility is $\pm$ 9.74 $\cdot$ 10^{-7} sec^{-1}; the long term instability over one hour is $\pm$ 4.87 $\cdot$ 10^{-7} sec^{-1}; the scale factor is 1.15 $\cdot$ 10^5 Hz $\cdot$ sec. We shall assume ϕ = 60° and cosec A $\simeq$ 1. Using formulas (10), (7) and (8), we obtain respectively:

$$T = \frac{\sqrt{3}}{2 \cdot 0,56 \cdot 1/3 \cdot 0,2} = 23,2\text{s}; \quad \sigma_{A1} = \frac{1/3 \cdot 0,2}{15 \cdot \cos 60^\circ} = 30'6;$$

$$\sigma_{A2} = \frac{1}{2\sqrt{3} \cdot 23,2 \cdot 0,56 \cdot 15 \cdot \cos 60^\circ} = 10',2.$$

Using formulas (16) and (17), we compute that: $\left(\sigma_a = \frac{0,1 \cdot 0,56}{3 \cdot 3600} = 5,185 \cdot 10^{-6}\ \text{Hz} \cdot \text{s}^{-1}\right)$

$$T_r = \frac{1,52}{\sqrt{5,185 \cdot 10^{-6}}} = 666,7\text{s}; \quad \sigma_A = \frac{0,537 \cdot \sqrt{5,185 \cdot 10^{-6}}}{0,56 \cdot 15 \cdot \cos 60^\circ} = 1'.$$

The studies performed here allow for the conclusion that the problem of optimizing gyro-optical compass speed, where the compass operates on a stationary base, should be solved taking into account the model for the laser gyroscope errors and the algorithm for processing its output signal in the specific compass configuration.

BIBLIOGRAPHY

1. Fedorov, B.F., et al, "Opticheskiy kvantovy giroskop" ["An Optical Laser Gyroscope"], Moscow, Mashinostroyeniye Publishers, 1973.

2. Bychkov, S.I., et al., "Lazernyy giroscop" ["A Laser Gyroscope"], Moscow, Sovetskoye Radio Publishers, 1975.

3. Seregin, V.V., "O bystrodeystvii girooptícheskogo kompasa" ["On the Operational Speed of a Gyro-Optical Compass"], IZV. VUZOV SSSR, PRIBOROSTROYENIYE [PROCEEDINGS OF THE USSR HIGHER EDUCATIONAL INSTITUTES, INSTRUMENT CONSTRUCTION], 1975, Vol 18, No 12.

4. Seregin V.V., Smirnov, V.Ya., "K voprosu ob obrabotke informatsii v KOKG" ["On the Question of Data Processing in KOKG [not further defined]"], Abstract No 5.32.615, RZH METROLOGIYA I IZMERITEL'NAYA TEKHNIKA [JOURNAL OF ABSTRACTS IN METROLOGY AND INSTRUMENTATION ENGINEERING], 1976, No 5.

5. Malikov, M.F., "Osnovy metrologii" ["Fundamentals of Metrology"], Moscow, 1949.

6. Kuznetsov, G.M., et al., "Ob opredelenii azimuta lazernym giroskopom" ["On the Determination of Azimuth with a Laser Gyroscope"], IZV. VUZOV SSSR - PRIBOROSTROYENIYE, 1976, Vol 19, No 6.

7. Ivanov, V.A., Yalynychev, N.A., "K teorii pretsizionnogo indikatora meridiana" ["On the Theory of a Precision Meridian Indicator"], IZV. VUZOV SSSR - PRIBOROSTROYENIYE, 1968, Vol 21, No 6.

8. Langford, R., "Datchiki inertsial'nykh sistem na novykh fizicheskikh printsipakh" ["Inertial System Transducers using New Physical Principles"], VOPROSY RAKETNOY TEKHNIKI, 1966, No 9, 10.

[8144/681-8225]

8225
CSO: 8144/681

TURBINE AND ENGINE DESIGN

UDC 623.451.8(024)

ENGINEERING DESIGN OF SOLID-PROPELLANT GUIDED BALLISTIC MISSILES

Moscow INZHENERNOYE PROYEKTIROVANIYA UPRAVLYAYEMYKH BALLISTICHESKIKH RAKET S RDTT (Engineering Design of Guided Ballistic Missiles with Solid-Propellant Rocket Engines) in Russian 1979 signed to press 7 Mar 79 pp 1-4

[Annotation, table of contents and foreword from book by Yuriy Mikhaylovich Nikolayev and Yuriy Semenovich Solomonov, Voyenizdat, 5,500 copies, 240 pages]

[Text] The book sets forth the methods for designing guided ballistic missiles with solid-propellant based rocket engines that are used mainly during the initial stages of designing a missile system. It shows the importance of these methods to establishing the solutions that are incorporated in the development of a missile and to refining the possible values of its flight-engineering characteristics.

The book is intended for specialists who work in the rocket-engineering field and also for audiences and students of senior courses at higher educational institutions who are familiar with the basics of designing missiles.

The information cited in the book is based upon data published in the open domestic and foreign press.

Contents

Foreword

The designing of guided ballistic missiles is a complicated and important stage of developing them, in the process of which the mutually related problems of the missile as a whole and of its individual systems and components must be solved. This process presupposes a systematization and generalization of the experience gained in missile manufacture and the development of new methods for integrated analysis of a missile that consider more fully the mutual influence of various engineering solutions.

An attempt has been made in this book to set forth the subject matter of methods for designing guided ballistic missiles with RDTT's that are used in engineering practice at the initial stage of design.

Chapter 1 gives basic information about guided ballistic missiles, the stages and tasks of design, and the concept of missile-systems effectiveness.

Chapter 2 sets forth the bases of the theory of flight of ballistic missiles and the guidance of them, to the extent necessary for a rational choice of a missile's basic design parameters during ballistic design.

Chapter 3 contains basic information about the arrangement and operating principles of the main components and assemblies of a missile with RDTTs, including the nose cone, the control system, the system of defense against PRO and the systems that support its functioning, solid-propellant charges, and guidance and stabilization devices.

Later chapters analyze in detail the stage of preparation and establishment of the main baseline data for ballistic designing, and the tasks and subject matter of this important stage of the process of designing a missile as a whole are disclosed.

Design methods for weight-and-energy, geometric, and ballistic analyses that will enable the connection between the missile's basic design parameters and its flight-engineering characteristics to be established as applicable to the characteristics of certain standard conceptual and design-development schemes for rockets and their components.

The numerical and factual data cited in the book are based upon information in the open domestic and foreign press.

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USSR UDC 629.78.076.6

OPTIMAL RATIO BETWEEN REACTION MASS AND NUCLEAR ELECTRIC POWER SOURCE IN AN ION ROCKET

Moscow IDEI K. E. TSIOLKOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 34-40

MERKULOV, I. A.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.84]

[Text] Problems of the theory of the optimization of the electrical rocket engine, whose utilization in rockets had in principle been proposed by Tsiolkovsky, are considered. Dimensionless criteria typifying ion-thruster rockets are derived. The optimal ratio between the reaction mass and the nuclear electric power source is demonstrated.
[456-1386]

USSR UDC 629.78.076.6

THEORY OF STAGED ACCELERATION

Moscow IDEI K. EL. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 46-50

KAZNEVSKIY, V. P.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.85]

[Text] The theory of the effectiveness of staged acceleration in discussed with respect to multistaged vehicles successively fueled during their acceleration from several mass carrier accumulators. A general formulation of Tsiolkovsky's classical equation applicable to the staged acceleration of multistaged vehicles is derived.
[456-1386]

USSR UDC 629.78.076.6

OPTIMIZATION ALGORITHM FOR A VEHICLE WITH A LIMITED-CAPACITY ENGINE

Moscow IDEI K. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 76-83

KONSTANTINOV, M. S.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.87]

[Text] The work of optimization of a spacecraft with an engine of limited capacity is analyzed with respect to the problem of a roundtrip flight between the orbits of an artificial satellite of Earth and an artificial satellite of Mars, on the assumption of coplanarity of the orbits of Earth and Mars, disregarding their eccentricity. The space of selectable parameters of the vehicle and the effectiveness of the algorithm, particularly with respect to the satisfaction of inequality-type conditions, are investigated. Figures 2; references 3.
[456-1386]

USSR UDC 629.764.7.001

DEVELOPMENT OF K. E. TSIOLKOVSKIY'S CONCEPT OF A STAGED ROCKET

Moscow IDEI K. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 23-34

VORBO'YEV, L. M.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.151]

[Text] The results of the development of Tsiolkovsky's concept of rocket stages are considered. A theory of the optimization of the basic design parameters of multistage rockets is presented. The domains of rational application of one-, two-, and three-stage rockets are described.
[456-1386]

USSR UDC 629.764.7.001

ANALYSIS OF MULTISTAGE SYSTEMS WITH THE AID OF A FUNCTIONAL DEPENDING ON THE WEIGHT OF COMPONENTS

Moscow IDEI I. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 41-45

BALASHOV, V. V.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.152]

[Text] The procedure for constructing a functional for the optimization of the basic parameters of multistage rockets with vertical launching and horizontal landing of the carrier and the orbital stage is examined. The introduction of generalized parameters into mass ratios was used in optimizing the rocket stage systems. References 2.
[456-1386]

USSR UDC 629.782.001

CERTAIN PROBLEMS OF THE DESIGN OF AIR-SPACE SHUTTLE SYSTEMS

Moscow IDEI K. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 113-122

BALASHOV, V. V.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.153]

[Text] Possible methods of spaceship launching as originally proposed by Tsiolkovskiy are examined. The present-day state of the art as regards the development of the space shuttle is analyzed. The basic problems of reusable vehicle design are discussed. Figures 2; references 2.
[456-1386]

USSR UDC 629.78:533.1

DYNAMIC PROCESSES OF TURBULENCE DEVELOPMENT IN LONGITUDINAL CURRENTS

KOSMICHESKIYE ISSLEDOVANIYA [Space Research] in Russian Vol 17 No 1, 1979 pp 60-68

GUDKOVA, V. A., VOLOSEVICH, A. V., LIPEROVSKIY, V. A. and SKURIDIN, G. A.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.117]

[Text] The dynamics of the processes of flow of magnetospheric longitudinal currents with developed anomalous drag is considered. It is shown that in a sufficiently narrow tube of force, processes of turbulent heating should result in disrupting the quasi-steady turbulent state. On the other hand, in a sufficiently broad tube of force the onset of a quasi-steady state is possible. In connection with the theoretical analysis, possible experimental techniques for investigating anomalous drag in a magnetospheric tube of force are considered. References 26.
[456-1386]

USSR UDC 629.78.015.4

SHELLS IN A STREAM OF FLUID AND GAS. PROBLEMS OF HYDROELASTICITY

Moscow OBOLOCHKI V POTOKE ZHIDKOSTI I GAZA. ZADACHI GIDROUPRUGOSTI in Russian, Nauka, 1979 320 pp.

VOL'MIR, A. S.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.179 K]

[Text] Transient processes in shell-fluid systems and echo signals generated in the fluid by shells under deformation are investigated. A special section deals with problems of hydrodynamics of blood circulation, which pertain to biophysics. The behavior of shells in non-detached flow (divergence, flutter in sub- and supersonic gas flow) and in stalled flow (buffeting, ash-caused oscillations, galloping) is investigated. The effect of atmospheric turbulence on civil-engineering structures is considered. Numerical and experimental methods in aero- and hydroelasticity

are reviewed. Converse problems of aeroelasticity associated with the identification of system parameters and external effects are investigated. The book is designed for scientists specializing in various domains of continuum mechanics, graduate students, advanced-course students in universities and higher educational institutions, and aircraft, shipbuilding, machine-building, and structural engineers. Figures 172; references 335.
[456-1386]

USSR UDC 629.78.076.6

DEPENDENCE OF SPHERICAL MOTIONS OF A SOLID ON STRUCTURAL, KINEMATIC, AND DYNAMIC PARAMETERS

Moscow IDEI K. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 61-72

DOBRONRAVOV, V. V.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.86]

[Text] The dependence of the spherical motions of a solid on structural, kinematic, and dynamic parameters is examined with respect to the motion of a spacecraft relative to its center of mass. It is shown that the solution of a number of known problems formulated in this study has a direct bearing on techniques for controlling automatic and manned spacecraft, whose principles had been formulated by K. E. Tsiolkovsky. References 5.
[456-1386]

USSR UDC 629.78.076.6

INTEGRABLE APPROXIMATION OF THE PROBLEM OF MOTION OF A POINT IN THE GRAVITATIONAL FIELD OF A DYNAMICALLY ASYMMETRIC BODY

KOSMICHESKIYE ISSLEDOVANIYA [Space Research] in Russian Vol 17 No 1, 1979 pp 161-164

OREKHOV, V. N.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.89]

[Text] The generalized problem of two fixed centers in which separation of variables yields a detailed qualitative analysis of motion may be regarded as an integrable approximation of the problem of motion of a material point in the gravitational field of a spheroidal body. The potential approximation proposed in this paper makes possible the separation of variables in the approximation problem for the case in which the attracting body has a triaxial central ellipsoid of inertia. References 6.
[456-1386]

USSR UDC 629.78.076.6

OBSERVABILITY OF THE TRAJECTORY OF MOTION OF A SPACECRAFT

IZVESTIYA LENINGRADSKOGO ELEKTROTEKHNICHESKOGO INSTITUTA [Bulletin of Leningrad Electrical Engineering Institute] in Russian No 241, 1978 pp 31-37

SIDOROV, A. S.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.93]

[Text] The application of general methods of the theory of observability of nonlinear dynamic objects to a particular problem of determining motion on the basis of measurement data is considered. The conditions under which an unequivocal reconstruction of the unperturbed Keplerian orbit of a spacecraft with an incomplete set of sensors is possible are determined. An orbit reconstruction algorithm is proposed. Figures 3, references 7.
[456-1386]

USSR UDC 629.78.015.4

ELASTOPLASTIC FLEXURE OF A VARIABLE-RIGIDITY ANNULAR PLATE UNDER A LOCALIZED LOAD

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 3-10

BINKEVICH, YE. V. and ULANOVA, N. P.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No. 7.41.176]

[Text] An algorithm for a numerical solution of the problem of the elastoplastic buckling of asymmetrically loaded plates with a rigidity having a square-law variation is constructed. On the basis of Budyanskiy's criterion the possibility of applying the theory of small elastoplastic deformations to the solution of this problem is substantiated. Figures 3, references 7.
[456-1386]

USSR UDC 629.78.015.4

A COMPLEX METHOD FOR THE ANALYSIS OF PLATES WITH SPECIAL DESIGN FEATURES

Moscow TEMATICHESKIY SBORNIK NAUCHNYKH TRUDOV. MOSKOVSKIY AVIATSIONNYY INSTITUT [Thematic Collection of Scientific Papers. Moscow Aviation Institute] in Russian No 467, 1978 pp 51-54

MATYUSHEV, YU. S., BRODSKIY, S. I., and MOVCHAN, A. A.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.4.177 by T. A. Ye.]

[Text] When allowance is made for every possible design feature (stiffening fins, contour elements, notches and their reinforcements), such effective approximation methods as the finite-difference method and the finite-element method are inconvenient to apply in their classical matrix form, i.e. require an extensive computer memory. Direct methods occupy a small computer memory but then the time of the solution of problems is extraordinarily long. The article proposes an algorithm based on the application of a modified conjugate-gradient method. The method as fast as matrix versions, and at the same time it occupies a much smaller volume of computer memory. Figures 2, references 2.
[456-1386]

USSR UDC 629.78.015.4

ANALYSIS OF A PRESSURIZED ORTHOTROPIC CYLINDRICAL SHELL WITH AN ELASTIC FILLER UNDER LOCALIZED LOADING

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 14-19

VLASENKO, I. N.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.180]

[Text] On the basis of the engineering moment theory of anisotropic shells an equilibrium equation of a pressurized orthotropic cylindrical shell with an elastic filler is derived. Formulas for the analysis of stresses and strains also are derived. Sample calculations are presented. Figures 2, references 3.
[456-1386]

USSR UDC 629.78.015.4

EXPERIMENTAL INVESTIGATION OF THE EFFECT OF INITIAL DEVIATIONS OF SHAPE ON THE LOAD CAPACITY OF CYLINDRICAL SHELLS

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 19-26

GAYDUCHENKO, A. P., GUDRAMOVICH, V. S. and DEMENKOV, A. F.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.181]

[Text] A method for producing cylindrical shells with specified initial deviations of shape is described. The behavior of cylindrical shells with artificially induced initial deviations of shape under the action of a combination of axial stress and external pressure is experimentally investigated. Experimental and theoretical findings on the load capacity of shells are presented. Figures 7, references 4.
[456-1386]

USSR UDC 629.78.015.4

INVESTIGATION OF THE LOCAL STABILITY OF STRUCTURALLY ANISOTROPIC SHELLS

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 53-58

YERSHOV, N. P.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.182]

[Text] Experimental findings on plates with zero positive Gaussian curvature under the combined load of normal pressure and compressive stress are analyzed. Conditions for integrity of the shells are derived with respect to specified safety margins, and the necessary geometrical parameters are found for the area between stiffening ribs to ensure reliable performance of reinforced shells under local loading, are derived. Figures 3.
[456-1386]

USSR UDC 629.78.015.4

CONTACT INTERACTION OF A CYLINDRICAL CONTAINER WITH UNILATERAL ELASTIC BRACKETS

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 64-73

KATAN, L. I. and MAKEYEV, YE. M.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.183]

[Text] The contact interaction between a cylindrical shell and arbitrarily positioned unilateral elastic brackets of varying extent is investigated. The resolving system of nonlinear algebraic equations derived by the trigonometric series method is linearized by an iterative process. Sample calculations are presented. Figures 3, references 5.
[456-1386]

USSR UDC 629.78.015.4

BUCKLING OF CYLINDRICAL SHELLS UNDER COMBINED LOADING IN THE PRESENCE OF CREEP

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 89-95

POSHIVALOV, V. P.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.184]

[Text] The buckling of cylindrical shells under the combined load of an axial compressive stress and internal pressure in the presence of creep is examined. A hardening theory is applied. The fundamental equations are linearized by a method of sequential loading. Sample calculations of the buckling of a cylindrical shell in the presence of creep are examined. Figures 7, references 6.
[456-1386]

USSR UDC 629.78.015.4

ADAPTABILITY OF THIN SHELLS IN THE JUNCTION ZONE

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 95-102

SEL'SKIY, YU. S.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.185]

[Text] A relationship between the stress concentration in the elastic stage and the critical load adaptability is established on the basis of an approximate method for taking adaptability into account. The limiting internal pressure in the zone of contact between a cylindrical branch pipe and a spherical vessel, and in the region of the attachment of a conical bottom to a cylindrical shell, is determined. Figures 3, references 3.
[456-1386]

USSR UDC 629.78.015.4

PLASTIC BUCKLING OF COMPOSITE SHELLS

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 34-41

GUDRAMOVICH, V. S. and KONOVALENKOV, V. S.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.186]

[Text] The authors consider purely plastic bulging of a thinwalled system consisting of a cylindrical shell abutting to two conical shells. One edge of this system is clamped, and the other edge is free. The small-parameter method is applied and formulas of the deformation theory and of the flow theory for a diagram with linear hardening are utilized. Figures 1, references 4.
[456-1386]

USSR UDC 629.78.915.4

CERTAIN FORMULAS OF THE THEORY OF MIDDLE BENDING OF FLAT SHELLS HAVING A COMPLEX GEOMETRY

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems] in Russian, 1979 pp 26-33

GALIMOV, K. Z., KORNISHIN, M. S. and PAYMUSHIN, V. N.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.187]

[Text] A variational equation of the theory of the mean flexure of flat shells, analogous to the formula of N. A. Alumyae, is derived on the basis of certain transformations of the Lagrange variational equation for the case in which shells on the tangential stress contour represent specified quantities. Resolving equations and boundary conditions relative to the bending of the shells are derived in general coordinates, and the functions of tangential forces are found on the basis of this equation for shells of complex geometry with a boundary on the middle surface that coincides with coordinate lines. References 6.
[456-1386]

USSR UDC 629.78.015.4

ON THE LINEAR THEORY OF TWO-LAYER SHELLS WITH LAYERS OF VARYING THICKNESS

Kuybyshev VOPROSY PROCHNOSTI I DOLGOVECHNOSTI ELEMENTOV AVIATSIONNYKH KONSTRUKTSIY

[Problems of the Strength and Durability of Structural Aircraft Components] in Russian No 4, 1978 pp 19-25]

PAYMUSHCHIN, V. N. and ODINOKOV, A. YU.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.188]

[Text] A linear theory of two-layer shells with layers of variable smoothly changing thickness is constructed. The thickness of these layers is assumed to be substantial, and hence the Timoshenko straight-line hypothesis is applied to the layers and allowance is made for the difference in the

metrics of their median surfaces, which are assumed to be mutually flat. Basic formulas of the deformation theory are derived with respect to the curvature lines of one of the layers. A system of seven differential equations of shell equilibrium is derived by a variational method; the common order of these equations is 14. This system, along with the static boundary conditions of the problem, is derived for the case in which the contour lines of the median surfaces of the layer coincide with coordinate lines and the boundary shear planes are formed by the motion of the normals along these lines. Figures 1, references 7.
[456-1386]

USSR UDC 629.78.017.1

STRENGTH AND RELIABILITY OF COMPLEX SYSTEMS

Kiev PROCHNOST' I NADEZHNOST' SLOZHNYKH SISTEM [Strength and Reliability of Complex Systems], Collected Scientific Papers, Dnepropetrovsk Department of the Academy of Sciences USSR in Russian, Nauk. Dumka, 1979 204 pp

Dnepropetrovsk Affiliate of the USSR Academy of Sciences

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.190 K]

[Text] Current problems of the theory of the strength and reliability of complex systems are discussed. Theoretical and experimental findings on bearing capacity and stability as well as on the stress-strain state of shell structures under non-uniform loads and in the presence of contact interactions (with, in this case, allowance for the physical nonlinearity of the material) are presented. Probabilistic failure models are discussed in relation to the solution of durability problems. Certain problems of the random process overshoot theory are considered, as are approximation formulas for multivariate normal distribution functions and the problems of conducting speeded-up durability tests. The book is designed for researchers and engineers dealing with strength and reliability, as well as for graduate and advanced-course students majoring in the corresponding fields. Figures.
[456-1386]

USSR UDC 629.78.076.6

GENERALIZED EQUATIONS OF CONTROLLABLE SPACECRAFT SPIN

Moscow IDEI K. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 98-104

GARTUNG, YU. A. and LOYENKO, YU. M.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.88]

[Text] A system of differential equations of controlled spherical motion of a solid, programmed with the aid of differential constaints of a general kind, is constructed. General formulas for computing the corresponding control actions are derived. Cases of natural realization of the constraints in question are considered. References 4.
[456-1386]

USSR UDC 629.78.017.2

DYNAMICS OF A FLYWHEEL SYSTEM FOR CONTROLLING THE MOTION OF A SPACECRAFT RELATIVE TO ITS CENTER OF MASS WITH ALLOWANCE FOR ELASTIC ELEMENTS

Moscow IDEI K. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovskiy's Ideas in Present-Day Light] in Russian, 1979 pp 83-90

POPOV, V. I. and SEVEROVA, L. V.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.110]

[Text] The dynamics of a flywheel system for controlling the motion of a spacecraft relative to the center of mass is considered with allowance for elastic elements. A system of equations convenient for numerical realization in a computer is derived, and illustrative examples are presented along with an algorithm. Figures 4, references 5.
[456-1386]

USSR UDC 629.78.017.2

OPTIMAL CONTROL OF THE REORIENTATION OF A GYROSTATIC SATELLITE

KOSMICHESKIYE ISSLEDOVANIYA [Space Research] in Russian Vol 17 No 1, 1979 pp 18-23

ZLOCHEVSKIY, S. I.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.113]

[Text] The problem of reorienting a gyrostatic satellite in a circular orbit within a Newtonian gravitational field is considered. The optimal pattern of control of the kinetic moments of three flywheels installed along the major axes of inertia of the satellite is synthesized. The integral r.m.s. functional of the components of the kinetic moment of the flywheel is minimized. References 10.
[456-1386]

USSR UDC 629.78.064.2(088.83)

DUAL-RANGE PRESSURE CONTROLLER

USSR Author's Certificate Cl. G 05 D 16.06, No 594488, filed 9 Jan 73, No 1868828, published 24 Mar 78

BAVAROVSKIY, L. S., DOBKIN, R. I., LASTOCHKIN, A. D., RATMANSKIY, O. I., Kievpromarmatura Scientific Production Association

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.194 P]

[Text] This invention concerns a direct-action gas controller and may be used in flight-vehicle pneumatic systems. The traditional 2-range pressure governor contains a casing with inlet and outlet branch pipes, a main spring-loaded sensor, a lid, and an adjuster. A shortcoming of the traditional 2-range governor, whose adjuster is air-driven, is the need to install an additional 3-way electropneumatic valve, a main pipe, a piston, and two drain lines for the idle passage of the working medium. To reduce energy losses and simplify the governor, the adjuster is designed in the form of an electromagnet mounted in the lid. The armature of the electromagnet is connected via a bracket to one end of an extra spring contacting the sensor; the other end of the spring is connected via an adjustment screw to the lid. Figures 1.
[456-1386]

USSR UDC 629.78:531.768(088.83)

ACCELEROMETER

USSR Author's Certificate G 01 P 15/02, No 605179, filed 6 Jan 75, No 2093093, published 21 Apr 78

GALKIN, YU. S., KRUTSKIKH, Z. A., GRIGOR'YEV, G. A., KORYAGIN, A. V., KAGAN, M. G. and PISAREV, G. N.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.234 P]

[Text] The invention pertains to an accelerometer and may be used in homing systems as well as in systems for measurement of small linear accelerations of missiles and spacecraft. The traditional accelerometers contain an inertial mass in the shape of a bushing mounted on a shaft whose rotation generates a gas-dynamic bearing; a flexible nylon thread with a negligibly small cross-rigidity, whose one end is attached to the inertial mass and the other, to a fixed casing serving as a converter of gas-dynamic friction to an axial stress impeding the movement of the inertial mass under the action of angular acceleration; and a recording device. A shortcoming of such conventional accelerometers is stable sub-harmonic oscillations of the inertial mass relative to the axis of the suspension, which oscillations alter the output characteristic of the device. These oscillations are due to the following factors: 1) the presence of a small curvature of the restoring system, corresponding to a thread tension of the order of 0.05 gf; 2) the presence of perturbations induced in the inertial mass by the rotating shaft, as reflected in the wobble of the shaft surface relative to the rotational axis of the shaft; and 3) the presence of nonlinearity of the force characteristic of the thread when under low tension, owing to the aerodynamic moment of friction. The aim of the invention is to dampen the radial oscillations of the sensory element and to enhance the stability of the accelerometer's output characteristic. To accomplish this aim, the accelerometer thread is profiled in a plane in the form of segments of arcs. Figures 3. [456-1386]

USSR UDC 629.78.017.2

CYCLIC OPTIMAL MANEUVERING MODES AND THEIR REALIZATIONS

Moscow IDEI K. E. TSIOL'KOVSKOGO I SOVREMENNOST' [K. E. Tsiolkovsky's Ideas in Present-Day Light] in Russian, 1979 pp 91-98

GURMAN, V. I. and NIKULIN, A. M.

[From REFERATIVNYY ZHURNAL 41. RAKETOSTROYENIYE No 7, 1979 Abstract No 7.41.111]

[Text] A new type of maximally economical control modes for movements of the spacecraft center of mass and about that center by means of limited-thrust engines is derived with the aid of V. F. Krotov's optimality theory and the multiple-maximum method. The features of such control modes, termed cylic optimal modes, and the possibilities of implementing them are investigated. Figures 3, references 5.
[456-1386]

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